

WATER QUALITY IN OKLAHOMA

2008

INTEGRATED REPORT

PREPARED PURSUANT TO SECTION 303(D) AND SECTION 305(B) OF THE CLEAN WATER ACT

BY

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

EXHIBIT

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Acronyms and Definitions

Agencies

ODAFF	Oklahoma Department of Agriculture Food and Forestry
OCC	Oklahoma Conservation Commission
Corporation Commission	Oklahoma Corporation Commission
OSDH	Oklahoma State Department of Health
OSE	Office of the Secretary of Environment
DEQ	Oklahoma Department of Environmental Quality
OWRB	Oklahoma Water Resources Board
Wildlife Department	Oklahoma Department of Wildlife Conservation

Terminologies

- 303(d)** This section of the Clean Water Act requires each state to identify waters that do not or are not expected to meet applicable Water Quality Standards with technology-based controls alone. States are required to establish a priority ranking for the waters, taking into account the pollution severity and designated uses of the waters. Once identification and priority ranking are completed, states are to develop Total Maximum Daily Loads at a level necessary to achieve the applicable state Water Quality Standards.
- 304(l)** This section of the Clean Water Act requires each state to identify those waters that fail to meet Water Quality Standards due to toxic pollutants and other sources of toxicity. It also requires the preparation of individual control strategies that will reduce point source discharges of toxic pollutants.
- 305(b)** This section of the Clean Water Act requires each state to report its water quality on a biennial cycle.
- 314** This section of the Clean Water Act requires each state to establish a Lake Water Quality Assessment Report. This section provides federal funds for the state to submit a classification of lakes according to trophic condition, develop processes and methods to control sources of pollution and to work with other agencies in restoring the quality of those lakes. Section 314 establishes the guidelines for conducting Clean Lake Studies Phase I and II.
- 319(h)** This section of the Clean Water Act requires each state to develop a State Assessment Report and a Management Program for Nonpoint Source pollution problems. The Assessment Report is to describe the nature, extent, and effects of Nonpoint Source pollution, the causes and sources of such pollution, and programs and methods used for controlling this pollution.

BMPs	Best Management Practices: A technique that is determined to be the most effective, practical means of preventing or reducing pollutants from nonpoint sources in order to achieve water quality goals.
BOD₅	Biochemical Oxygen Demand (5-Day): The oxygen used in meeting the metabolic needs of aerobic microorganisms in water rich in organic matter -- called also biological oxygen demand; the test requires five days of laboratory time and results may vary when toxic substances are present which effect bacteria.
CBOD₅	Carbonaceous Biochemical Oxygen Demand (5-Day): That portion of the BOD that is not due to oxidation of nitrogenous compounds.
CTSI	Carlson's Trophic State Index ($CTSI = 9.81 \ln[chl-\alpha] + 30.6$).
CWA	Clean Water Act: Public Law 92-500 enacted in 1972 provides for a comprehensive program of water pollution control; two goals are proclaimed in this Act: (1) to achieve swimmable, fishable waters wherever attainable by July 1, 1983, and (2) by 1985 eliminate the discharge of pollutants into navigable waters.
DDT	Dichlorodiphenyltrichloroethane: A colorless odorless water-insoluble crystalline insecticide $C_{14}H_9Cl_5$ that tends to accumulate in ecosystems and has toxic effects on many vertebrates.
DO	Dissolved Oxygen: The amount of oxygen dissolved in water. DO concentrations range from a few parts per million up to about 10 ppm for most Oklahoma streams. A level of DO around 7 ppm is essential to sustain desired species of game fish. If DO drops below 5 ppm the danger of a fish kill is present and malodorous conditions will result. The major factors determining DO levels in water are temperature, atmospheric pressure, plant photosynthesis, rate of aeration and the presence of oxygen demanding substances such as organic wastes. In addition to its affect on aquatic life, DO also prevents the chemical reduction and subsequent movement of iron and manganese from the sediments and thereby reduces the cost of water treatment.
µg/L	Microgram/liter.
NPDES	National Pollutant Discharge Elimination System: A permit program established by Section 402 of the Clean Water Act. This program regulates discharges into the nation's water from point sources, including municipal, industrial, commercial and certain agricultural sources.
NTU	Nephelometric Turbidity Units: The measurement of the extent or degree of cloudiness by means of a nephelometer (an instrument for determining the concentration or particle size of suspensions by means of transmitted or reflected light).
OKWBID	Oklahoma Waterbody Identification number: A unique identifier assigned to each waterbody in Oklahoma. For a complete description of OKWBIDs, please see Appendix A.
PCB(s)	Polychlorinated Biphenyl(s): Any of several compounds that are produced by replacing hydrogen atoms in biphenyl with chlorine, have various industrial applications, and are poisonous environmental pollutants which tend to accumulate in animal tissues.
pH	The negative logarithm of the effective hydrogen ion concentration or hydrogen-ion activity in gram equivalents per liter used in expressing both acidity and alkalinity on

	a scale whose values run from 0 to 14 with 7 representing neutrality, numbers less than 7 increasing acidity, and numbers greater than 7 increasing alkalinity.
Playa Lakes / Prairie Potholes	Shallow, small, ephemeral to permanent closed basin lake, typically found in high plains and deserts.
TDS	Total Dissolved Solids: The complete amount of solid matter dissolved in water or wastewater.
TMDL	Total Maximum Daily Load: The sum of individual wasteload allocations for point sources, safety, reserves, and loads from nonpoint source and natural backgrounds.
WLA	Wasteload Allocation: The assignment of target loads to point sources so as to achieve Water Quality Standards in the most efficient manner. The wasteload allocation is designed to allocate or allow certain quantities, rates or concentration of pollutants discharged from contributing point sources which empty their effluent into the same river segment. The purpose of the wasteload allocation is to eliminate an undue "wasteload burden" on a given stream segment.
WQS	Water Quality Standards: rules which establish classifications of uses of waters of the state, criteria to maintain and protect such classifications, and other standards or policies pertaining to the quality of such waters. The purpose of the Standards is to promote and protect as many beneficial uses as are attainable and to assure that degradation of existing quality of waters of the State does not occur. These rules can be found at OAC 785:45.

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Executive Summary/Overview

Clean Water Act (CWA) Section 303(d) Requirements

The 1972 amendments to the Clean Water Act include Section 303(d). The regulations implementing Section 303(d) require states to develop lists of water bodies that do not meet water quality standards and to submit updated lists to the U. S. Environmental Protection Agency (EPA) every two years. Water quality standards, as defined in the Code of Federal Regulations, include beneficial uses, water quality objectives (narrative and numerical) and anti-degradation requirements. The EPA is required to review impaired water body lists submitted by each state and approve or disapprove all or part of the list.

For waterbodies on the 303(d) list, the Clean Water Act requires that a pollutant load reduction plan or TMDL be developed to correct each cause of impairment. TMDLs must document the nature of the water quality impairment, determine the maximum amount of a pollutant which can be discharged and still meet standards, and identify allowable loads from the contributing sources. The elements of a TMDL include a problem statement, description of the desired future condition (numeric target), pollutant source analysis, load allocations, description of how allocations relate to meeting targets, and margin of safety.

CWA Section 305(b) Requirements

The 1972 amendments to the Clean Water Act also include Section 305(b). The regulations implementing Section 305(b) require states to develop an inventory of the water quality of all water bodies in the state and to submit an updated report to the EPA every two years. This process was established as a means for the EPA and the U. S. Congress to determine the status of the nation's waters.

The 305(b) Report also includes: an analysis of the extent to which water bodies comply with the "fishable/swimmable" goal of the CWA; an analysis of the extent to which the elimination of the discharge of pollutants and a level of water quality achieving the "fishable/swimmable" goal have been or will be attained, with recommendations of additional actions necessary to achieve this goal; an estimate of a) the environmental impact, b) the economic and social costs, c) the economic and social benefits, and d) the estimated date of such achievement; and finally, a description of the nature and extent of nonpoint sources of pollutants, and recommendations of programs needed to control them- including an estimate of the costs of implementing such programs.

Integrated Report Guidance

The US Environmental Protection Agency (USEPA) issued guidance (USEPA, 2005) for the development of an Integrated Water Quality Monitoring and Assessment Report (Integrated Report) by the States. This guidance recommends that States integrate their Water Quality Inventory Report (Section 305(b) of the CWA) and their Impaired Waterbodies List (Section 303(d) of the CWA). The Integrated Report is intended to provide an effective tool for maintaining high quality waters and improving the quality of waters that do not attain water quality standards. The Integrated Report will also provide water resources managers and citizens with detailed information regarding the following:

- Delineation of water quality assessment units providing geographic display of assessment results
- Progress toward achieving comprehensive assessment of all waters
- Water quality standards attainment status
- Methods used to assess water quality standards attainment status
- Additional monitoring needs and schedules
- Pollutants and watersheds requiring Total Maximum Daily Loads (TMDLs)
- Pollutants and watersheds requiring alternative pollution control measures
- Management strategies (including TMDLs) under development to attain water quality standards
- TMDL development schedules

The Integrated Report will streamline water quality reporting since data sources and assessment methods will be described in detail, providing a sound technical basis for assessment decisions. Assessment results will also be

conveyed in a spatial context, allowing a clearer picture of water quality status and issues. Monitoring needs and schedules will be described, facilitating the articulation of monitoring priorities and identifying opportunities for cooperation with other agencies and watershed partners. TMDL needs and schedules will be defined to convey plans for water quality improvements. The public participation aspects will provide opportunities for data submittal and open discussion of water quality assessment methods and results.

The Integrated Report combines the non-regulatory requirements of the Water Quality Inventory Report (305b) with regulation driven List of Impaired Waterbodies (303d) (i.e., only the latter mandates TMDL development). Successful integration into a single report requires a careful meshing of requirements and procedures. In general, Category 5 of the Integrated Report satisfies USEPA reporting requirements under Section 303d (Impaired Waterbodies) and combined with the remaining Categories document assessment under Section 305b (Water Quality Inventory). Therefore, the regulatory requirements (i.e., EPA approval and adoption; public participation, etc.) for 303d impaired waterbodies listing only apply to Category 5 of the Integrated Report.

The methods used to develop the 2008 Integrated Report (and subsequent Reports) are described in the Continuing Planning Process (CPP). One goal of the CPP is to provide an objective and scientifically sound waterbody assessment listing methodology including:

- A description of the data that the State will use to assess attainment of surface water quality standards
- The quality assurance aspects of the data
- A detailed description of the methods used to evaluate water quality standards attainment
- The placement of waterbodies in one of 5 Categories:

Category 1 - Attaining the water quality standard and no use is threatened.

Waterbodies listed in this category are characterized by data and information that meet the requirements of the CPP to support a determination that the water quality standard is attained and no use is threatened. Consideration will be given to scheduling these waterbodies for future monitoring to determine if the water quality standard continues to be attained.

Category 2 - Attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened.

Waterbodies listed in this category are characterized by data and information which meet the requirements of the CPP to support a determination that some, but not all, uses are attained and none are threatened. Attainment status of the remaining uses is unknown because there is insufficient or no data or information. Monitoring shall be scheduled for these waterbodies to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information was previously insufficient to make a determination.

Category 3 - Insufficient or no data and information to determine if any designated use is attained.

Waterbodies are listed in this category when the data or information to support an attainment determination for any use is not available, consistent with the requirements of the CPP. To assess the attainment status of these waterbodies, supplementary data and information shall be obtained, or monitoring shall be scheduled as needed.

Category 4 - Impaired or threatened for one or more designated uses but does not require the development of a TMDL.**4A - TMDL has been completed.**

Waterbodies are listed in this subcategory once all TMDL(s) have been developed and approved by EPA that, when implemented, are expected to result in full attainment of the standard. Where more than one pollutant is associated with the impairment of a waterbody, the waterbody will remain in Category 5 until all TMDLs for each pollutant have been completed and approved by EPA. Monitoring shall be scheduled for these waterbodies to verify that the water quality standard is met when the water quality management actions needed to achieve all TMDLs are implemented.

4B - Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future.

Consistent with the regulation under 130.7(b)(i),(ii), and (iii), waterbodies are listed in this subcategory when other pollution control requirements required by local, state, or federal authority are stringent enough to implement any water quality standard (WQS) applicable to such waters. These requirements must be specifically applicable to the particular water quality problem. Monitoring shall be scheduled for these waterbodies to verify that the water quality standard is attained as expected.

4C - Impairment is not caused by a pollutant.

Waterbodies are listed in this subcategory if the impairment is not caused by a pollutant. Scheduling of these waterbodies for monitoring to confirm that there continues to be no pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment, shall be considered.

Category 5 - The water quality standard is not attained. The waterbody is impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL.

This category constitutes the Section 303(d) list of waters impaired or threatened by a pollutant(s) for which one or more TMDL(s) are needed. A waterbody is listed in this category if it is determined, in accordance with the CPP, that a pollutant has caused, is suspected of causing, or is projected to cause an impairment. Where more than one pollutant is associated with the impairment of a single waterbody, the waterbody will remain in Category 5 until TMDLs for all pollutants have been completed and approved by EPA. For waterbodies listed in this category, monitoring schedules shall be provided that describe when data and information will be collected to support TMDL establishment and to determine if the standard is attained. While the waterbody is being monitored for a specific pollutant to develop a TMDL, the watershed shall also be monitored to assess the attainment status of other uses. A schedule for the establishment of TMDLs for all waters in Category 5 shall be submitted. This schedule shall reflect the priority ranking of the listed waters. Category 5 waterbodies are further divided into the following subcategories:

5A - TMDL is underway or will be scheduled.**5B - A review of the water quality standards will be conducted before a TMDL is scheduled.****5C - Additional data and information will be collected before a TMDL or review of the water quality standards is scheduled.**

The CPP will provide a companion to the 2008 Integrated Report. It is anticipated that this will be a living document and will be modified, as appropriate, to accompany subsequent Integrated Reports.

Oklahoma's comprehensive waterbody category list is available in Appendix B. Category 5 waterbodies can be viewed exclusively in Appendix C.

Synopsis

During the 2007/2008 reporting cycle, there were a total of 4,064 waterbodies delineated into the Oklahoma Assessment Database (ADB). These waters include approximately 637,326 lake acres, and 32,349 river and stream miles, of which approximately 517 miles form the border with the State of Texas.

The water quality data used in this report was collected by the Oklahoma Conservation Commission (OCC), Oklahoma Department of Environmental Quality (DEQ), Oklahoma Corporation Commission (Corp. Comm.), Oklahoma Water Resources Board (OWRB), United States Geological Survey, Tulsa Public Works & Development Department, Cherokee Nation, and citizens of the state. Only data collected prior to April 30, 2007 was utilized for this report.

Data used in this report came from several sources, including the *Toxics Monitoring Survey of Oklahoma Reservoirs* (OSDH, 1995), *Nonpoint Source Pollution Assessment Report (Section 319(h))* (OCC, 1988, 1994), *Clean Lakes Programs (Section 314)* (OCC & OWRB), *Lake Water Quality Assessment Report* (OCC & OWRB, 1994), *The State of Oklahoma 2006 Water Quality Assessment Integrated Report* (ODEQ, 2006), *Data Gaps Monitoring Projects* (OCC 2002, 2003), *Beneficial Use Monitoring Program*, *Rotating Basin Monitoring Program*, intensive and rapid bio-assessment surveys, fish and wildlife kill reports, spill reports, and citizen complaints. Historical data and assessments (prior to May 1, 2002) were only used when insufficient current data was available to assess a waterbody.

The State considers data gathered by interested citizens of the state of Oklahoma to be an important part of the water quality assessment process. Two organizations that help by contributing to this process are Blue Thumb and Oklahoma Water Watch. Volunteers collect water quality samples and deliver those samples to water quality professionals for analysis and assessment. For more information on Blue Thumb, contact the Oklahoma Conservation Commission. For more information on Oklahoma Water Watch, contact the Oklahoma Water Resources Board.

Additional monitoring will allow the state agencies to refine and modify the descriptions of the quality of the state's waters. This report reflects water quality determinations made in the past and such determinations will be confirmed or modified, as additional monitoring data becomes available. Where some waterbodies are indicated to be impaired, and suspected cause of impairment is listed, this information is also subject to confirmation or modification based on additional studies and evaluation by state agencies.

Table 1 shows the size and number of lakes in the state of Oklahoma designated as one of the five available categories outlined in the Integrated List Guidance above, while Table 2 does the same for river and stream miles.

TABLE 1. LAKE CATEGORY SUMMARY

Category	Size (Acres)	Number of Waterbodies
1	0	0
2	22,052	5
3	15,150	269
4A	0	0
4B	0	0
4C	0	0
5A	598,595	145
5B	0	0
5C	1,350	1

TABLE 2. RIVER AND STREAM CATEGORY SUMMARY

Category	Size (Miles)	Number of Waterbodies
1	121	5
2	1,922	165
3	19,838	2,848
4A	564	29
4B	0	0
4C	0	0
5A	9,283	505
5B	135	11
5C	486	81

Table 3 details the attainment status of each designated beneficial use assigned to lake acres in Oklahoma, while Table 4 does the same for river and stream miles. Each beneficial use for a waterbody must have only one attainment status associated with that use: supporting, not supporting, insufficient information, or not assessed (no information). The methodology for assigning the attainment status of a beneficial use of a waterbody is outlined in the Assessment Methodology and Summary Data section of this report.

TABLE 3. LAKE BENEFICIAL USE SUPPORT SUMMARY

Use	Lake Acres				
	Total Size	Size Fully Supporting	Size Not Supporting	Size Not Assessed	Size with Insufficient Info
Aesthetic	637,326	279,158	97,755	14,834	245,579
Agriculture	637,326	464,606	15,955	15,149	141,616
Fish Consumption	637,326	0	0	637,326	0
Warm Water Aquatic Community	637,326	9,112	585,663	14,843	27,708
Navigation	84,440	84,440	0	0	0
Primary Body Contact Recreation	637,326	139,676	21,780	15,184	460,686
Public and Private Water Supply	593,714	165	66,222	22,659	504,668
Sensitive Water Supply	135,825	0	0	135,825	0

TABLE 4. RIVER AND STREAM BENEFICIAL USE SUPPORT SUMMARY

USE	River Miles				
	Total Size	Size Fully Supporting	Size Not Supporting	Size Not Assessed	Size with Insufficient Info
Aesthetic	32,325	4,756	501	17,584	9,484
Agriculture	32,269	7,258	3,628	17,739	3,645
Emergency Water Supply	1,520	1,520	0	0	0
Fish Consumption	32,336	1,748	1,084	28,419	1,085
Cool Water Aquatic Community Subcategory	1,595	401	428	571	195
Habitat Limited Aquatic Community Subcategory	716	24	166	414	111
Trout Fishery	34	0	1	24	9
Warm Water Aquatic Community Subcategory	30,084	1,904	5,833	16,364	5,984
Navigation	213	213	0	0	0
Primary Body Contact Recreation	31,250	756	7,699	21,504	1,291
Public and Private Water Supply	14,788	1,068	395	6,517	6,808
Sensitive Water Supply	1,510	0	0	1,510	0
Secondary Body Contact Recreation	1,118	123	163	671	161

Table 5 shows the number of lake acres impaired by specific pollutant and Table 6 shows the same for the number of river and stream miles.

TABLE 5. LAKE ACRES IMPAIRED BY SPECIFIC POLLUTANT

Cause	Size (Acres)
Oxygen, Dissolved	389,498
Turbidity	370,016
Color	89,117
Chlorophyll-a	66,222
pH	30,953
Enterococcus	21,780
Total Phosphorus	15,877
Total Dissolved Solids	15,015
Chloride	8,700
Sulfates	6,330

TABLE 6. RIVER AND STREAM MILES IMPAIRED BY SPECIFIC POLLUTANT

Impairment	Size (Miles)
Enterococcus	6,977
Turbidity	4,012
Escherichia coli	3,495
Fecal Coliform	3,094
Dissolved Oxygen	2,547
Total Dissolved Solids	2,277
Chloride	2,137
Sulfates	1,982
Lead	1,437
pH	762
Fishes Bioassessments (Streams)	633
Oil and Grease	545
Selenium	273
Phosphorus (Total)	160
Sedimentation/Siltation	151
Nitrates	118
Ammonia (Un-ionized)	115
Cadmium	101
Copper	95
Zinc	83
Chlorpyrifos	42
Chromium (Total)	42
Diazinon	29
DDT	19
Toxaphene	19
Arsenic	6
Barium	4
Total Coliform	4
Dieldrin	4
Silver	2

Table 7 shows the number of lake acres impaired by potential sources, and Table 8 shows the number of river and stream miles impaired by potential sources.

TABLE 7. LAKE ACRES IMPAIRED BY POTENTIAL SOURCE

Potential Source	Size (Acres)
Source Unknown	600,090
Rangeland Grazing	45,623
Wildlife Other than Waterfowl	45,623
Grazing in Riparian or Shoreline Zones	37,183
Wastes from Pets	20,553
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	17,945
Animal Feeding Operations (NPS)	17,914
Impacts from Land Application of Wastes	17,914
Sources Outside State Jurisdiction or Borders	17,914
Petroleum/Natural Gas Activities (Legacy)	35
Silviculture Harvesting	25

TABLE 8. RIVER AND STREAM MILES IMPAIRED BY POTENTIAL SOURCE

Potential Source	Size (Miles)
Source Unknown	9,898
Grazing in Riparian or Shoreline Zones	7,091
Rangeland Grazing	6,905
Wildlife Other than Waterfowl	6,887
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	6,740
Wastes from Pets	4,873
Residential Districts	4,486
Highway/Road/Bridge Runoff (Non-construction related)	4,111
Non-irrigated Crop Production	4,006
Municipal Point Source Discharges	3,274
Impacts from Land Application of Wastes	2,513
Petroleum/Natural Gas Activities	2,207
Total Retention Domestic Sewage Lagoons	1,245
Clean Sediments	1,094
Agriculture	1,091
Other Spill Related Impacts	676
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)	618
Animal Feeding Operations (NPS)	510
Industrial Point Source Discharge	465
Atmospheric Deposition - Acidity	380
Mine Tailings	236
Sources outside State Jurisdiction or Borders	177

Potential Source	Size (Miles)
Municipal (Urbanized High Density Area)	170
Landfills	167
Discharges from Municipal Separate Storm Sewer Systems (MS4)	127
Silviculture Harvesting	95
Dredging (E.g., for Navigation Channels)	67
Land Application of Wastewater Biosolids (Non-agricultural)	46
Releases from Waste Sites or Dumps	33
Impacts from Abandoned Mine Lands (Inactive)	30
Leaking Underground Storage Tanks	28
Natural Sources	21
Spills from Trucks or Trains	17
Discharges from Biosolids (SLUDGE) Storage, Application or Disposal	17
Surface Mining	14
CERCLA NPL (Superfund) Sites	12
Acid Mine Drainage	8

Surface Water Quality

Oklahoma's Water Quality Standards (WQS) are set forth under statutory authority of the OWRB authorized under 82 O.S. § 1085.30. Under these statutes, OWRB "is required to set water quality standards which are practical and in the best public interest and to classify the state's waters with respect to their best present and future uses. These WQS are designed to enhance the quality of the waters, to protect their beneficial uses, and to aid in the prevention, control and abatement of water pollution in the State of Oklahoma" (OWRB, 2006). The WQS have established designated beneficial uses and standards for all of Oklahoma's waters.

The overall support and attainment of the "fishable/swimmable" goals of the CWA is based upon "total waters." The EPA requires all states to report their attainment of the goals of the CWA based on total waters. Relying solely upon this portrayal probably overly inflates estimates of the impaired and threatened conditions of the state's waters since monitoring efforts are typically focused on known problem areas. It would be too cost prohibitive to assess all of the waters within the state. Therefore, all assessment work performed in the state is conducted in a manner that will best utilize available funding resources. For lake total water reporting, the acreage includes Natural Resource Conservation Service (NRCS) (formerly the Soil Conservation Service) assisted farm ponds. Oklahoma lists approximately 1,041,884 total lake acres for the state. Of this number, 330,000 acres comprise approximately 220,000 NRCS assisted farm ponds. These farm ponds are not included in EPA's total water database. Although not considered as "significant lakes," the state considers them as important natural resources for the agricultural and rural communities. These farm ponds provide a significant amount of water for livestock, a source of primary recreation for many, used as flood control devices, sediment catchments, and add to the recharge of groundwater aquifers.

Canals, laterals and most all of the wetlands have not been assessed for the goals of the CWA nor have they been assessed for their beneficial uses. Canals and laterals are manmade watercourses and have not been included in the Appendix A of the WQS. By default, these waters would be assigned primary protection under the 2006 WQS (OWRB, 2006). Due to a lack of funding, no assessment projects have been initiated on these types of waterbodies. Wetlands have not been assigned specific WQS and therefore fall under the same scenario as canals and laterals. Several projects and ventures have been initiated to inventory the wetlands within the state, but little assessment work has been completed.

The major factors affecting the overall use support of the rivers and streams of the state were from the following causes: pathogens, mineralization, and turbidity. The major factors affecting the overall use support of the lakes of the state were from the following causes: oxygen depletion, turbidity, and color.

All unlisted waters, not included in Appendix A of the WQS, are assumed to have the beneficial uses consistent with the CWA's primary protection requirements. All beneficial use determinations are subject to administrative proceedings including the public hearing process.

Currently, the DEQ develops draft National Pollutant Discharge Elimination System (NPDES) permits for the control and abatement of municipal and industrial pollution. The DEQ issues the final NPDES permit for municipalities and industrial dischargers. Permit compliance is monitored by both the discharger and inspectors for the DEQ.

Since the inception of the CWA in 1972 and its amendments, EPA administered the National Pollutant Discharge Elimination System (NPDES) program, which addresses the management of industrial and municipal wastewater discharges. Previously, the functions related to wastewater were found in the OSDH, for municipal wastewater, and the OWRB for industrial wastewater. The scattering of the NPDES jurisdiction between two agencies that were independently pursuing delegation of their portion from the NPDES program did not appear to be conducive for Oklahoma to assume the program from EPA. Consolidation of the two agencies into the DEQ in July 1993 solved this problem and the work began for the agency to develop its required program documents, rules and statute changes in preparation of submitting its formal NPDES application to EPA, Region 6 office in Dallas, Texas.

The DEQ obtained NPDES program assumption from EPA on November 19, 1996. This is indicative of the agency having jurisdiction over the basic permitting, compliance and enforcement elements of the NPDES program, in addition to having authority over toxicity reduction, sewage sludge and pretreatment programs. In September 1997, program assumption to issue storm water permits was obtained from EPA.

Ground Water Quality

The goals of the Safe Drinking Water Act (SDWA) are that the nation's groundwater be free of harmful levels of contaminants and they set national standards for drinking water. Several state agencies are involved in the protection of Oklahoma's groundwater. These include the DEQ, ODAFF, Corporation Commission, OCC, and the OWRB. The DEQ is designated as the lead agency for the Wellhead Protection Program (WHPP).

There are instances of man induced groundwater pollution in the state. Except in a few old oilfields, they appear to be isolated instances and not general contamination of groundwater drinking water supplies. Historical data indicates water is of good quality from most aquifers.

Oklahoma has Groundwater Standards located in OAC 785:45-7. Designated beneficial uses for the groundwaters of the state are determined by Total Dissolved Solids (TDS). Groundwater with a mean concentration of TDS of less than 3,000 milligrams per liter has assigned beneficial uses of Public and Private Water Supply, Agriculture, and Industrial and Municipal Process and Cooling Water. Groundwater with a mean concentration of TDS of greater than or equal to 3,000 milligrams per liter but less than 10,000 milligrams per liter has assigned beneficial uses of Agriculture and Industrial and Municipal Process and Cooling Water. Groundwater is protected to background quality and, once polluted as a result of human activities, is restored to a quality to support its designated beneficial uses. Ensuring that groundwater meets Water Quality Standards is an important reason for developing and continuing a Water Quality monitoring Program.

Background

Diversity and Ecology

Oklahoma is a diverse state in its ecology, geology, hydrology, and its rainfall. Oklahoma is comprised of the following ecoregions: Arkansas Valley, Boston Mountains, Central Great Plains, Central Irregular Plains, Central Oklahoma/Texas Plains, Flint Hills, Ouachita Mountains, Ozark Highlands, South Central Plains, Southwestern Tablelands, and Western High Plains. These ecoregions (Figure 1) range from short grass prairies to Loblolly Pine (*Pinus taeda*)/Short-leaf Pine (*P. echinata*)/Oak (*Quercus* spp.) mixed community.

Much of Oklahoma's original plant and some animal species are either extinct or are greatly reduced in their distribution. The reduction in native vegetation is mainly due to cultivation, conversion of native prairie to pasture, timber cutting, and erosion. There are approximately 2,540 species of plants, 81 species of reptiles, 53 species of amphibians, 101 species of mammals, 400 species of birds, and 175 species of fish. Agriculture is the number one land use business in the state. Wheat is the number one cash grain crop grown in Oklahoma. Wheat is valuable during the winter as pasture feed for cattle, sheep and dairy stock. Other important grain crops for the state include fall and spring oats, barley, rye, sorghum, soybeans, and corn. In addition, pecans, fruits, vegetables, cotton, and timber all constitute a significant source of income for the state. Other important agricultural land use practices include cattle, dairy stock, sheep, poultry, and select exotics (e.g., llamas and ostriches).

The latitude and longitude coordinate for the corners of the state, excluding the Panhandle are: Southeast 033°38'15"/094°29'08"; Northeast 036°59'54"/094°37'04"; Southwest 034°33'38"/100°00'00"; and Northwest 037°00'00"/100°00'00". The coordinates for the Panhandle are: Southeast 036°30'00"/100°00'00"; Northeast 037°00'00"/100°00'00"; Southwest 036°30'00"/103°00'00"; and Northwest 037°00'00"/103°00'00". Oklahoma runs approximately 481.51 miles east to west and 230.16 miles north to south. The surface area of Oklahoma occupies approximately 69,919 square miles or 44,000,000 acres. Oklahoma varies in its elevation from its lowest point of 287 feet above sea level on the Little River in McCurtain County on the border with Arkansas to its highest point of 4,973 feet above sea level, near Black Mesa in Cimarron County on the border with New Mexico. There are ten major geologic provinces in Oklahoma with the Northern Shelf Areas being the largest (Figure 2) (Oklahoma Geological Survey, 1972). Oklahoma is composed of 77 counties with Osage being the largest (Figure 3). Basic statistics on Oklahoma can be found in Table 9.

Information contained in Table 9 came from a variety of sources including the 2000 Oklahoma Census, United States Geological Survey data, the OWRB data, Oklahoma Water Atlas, Reach File 3/Digital Line Graph Data, ground surveys, the Wildlife Department, United States Fish and Wildlife Service, and planimeter data. For the lakes information, Oklahoma uses the information from the *Oklahoma Water Atlas*. Oklahoma's environmental agencies feel that the information contained in the *Oklahoma Water Atlas* better represents the total of lakes and lake acres contained within the state. For the remaining rivers, creeks, canals and laterals we will be using a combination of sources for our data.

The total of fresh-water wetland acres was derived from information obtained from the Wildlife Department and United States Fish and Wildlife Service reports *Riparian Areas of Western Oklahoma* and *Bottomland Hardwoods of Eastern Oklahoma*. These reports contain information on 58 of the 77 counties in the state. The information in Table 9 was derived from taking the total of the largest most recent estimate for each county listed in the two reports. This total underestimates the actual number of wetland acres for the state and should be used with extreme caution when making comparison or trend analysis on Oklahoma's loss of wetlands.

FIGURE 1. ECOREGIONS OF OKLAHOMA

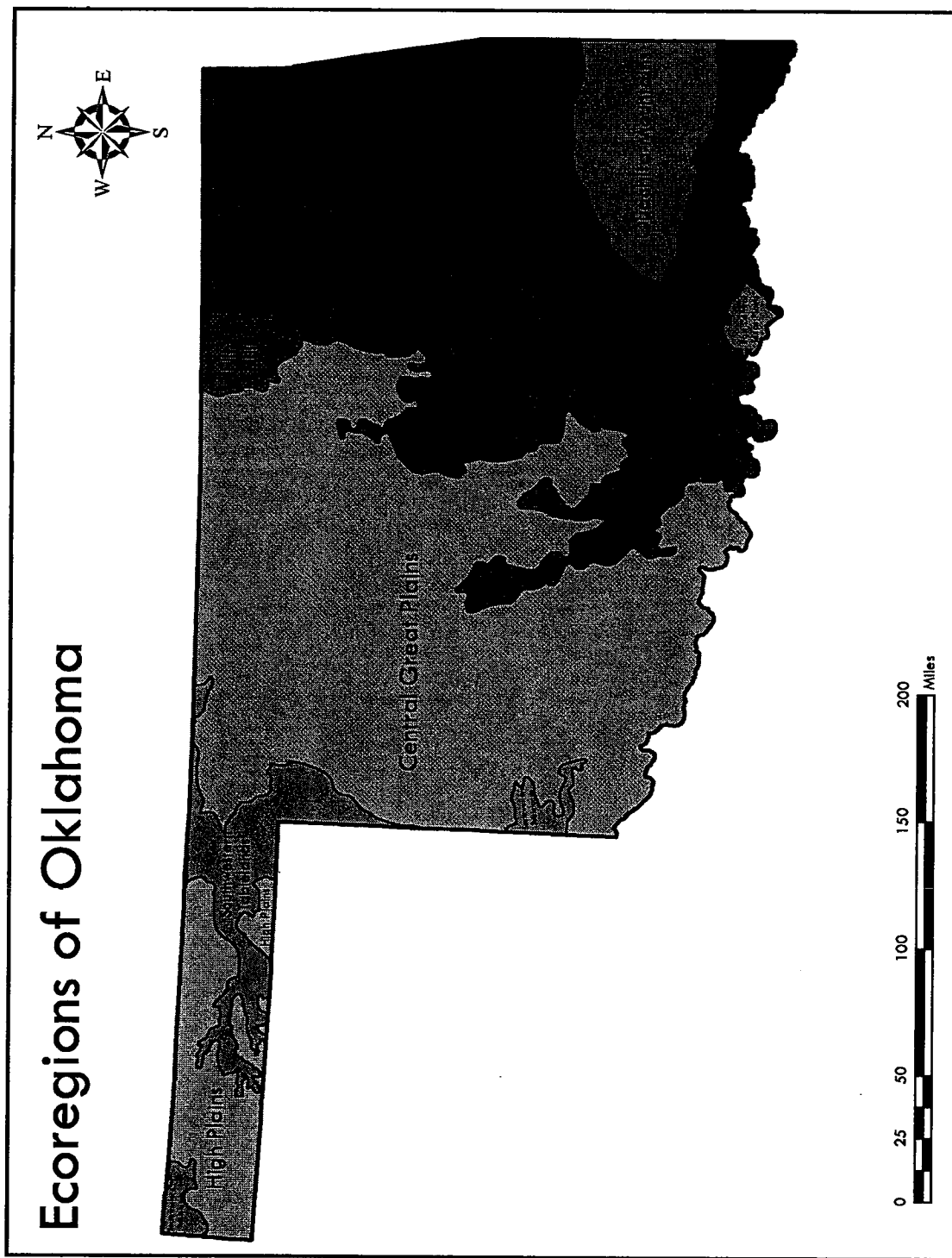


FIGURE 2. OKLAHOMA GEOLOGY

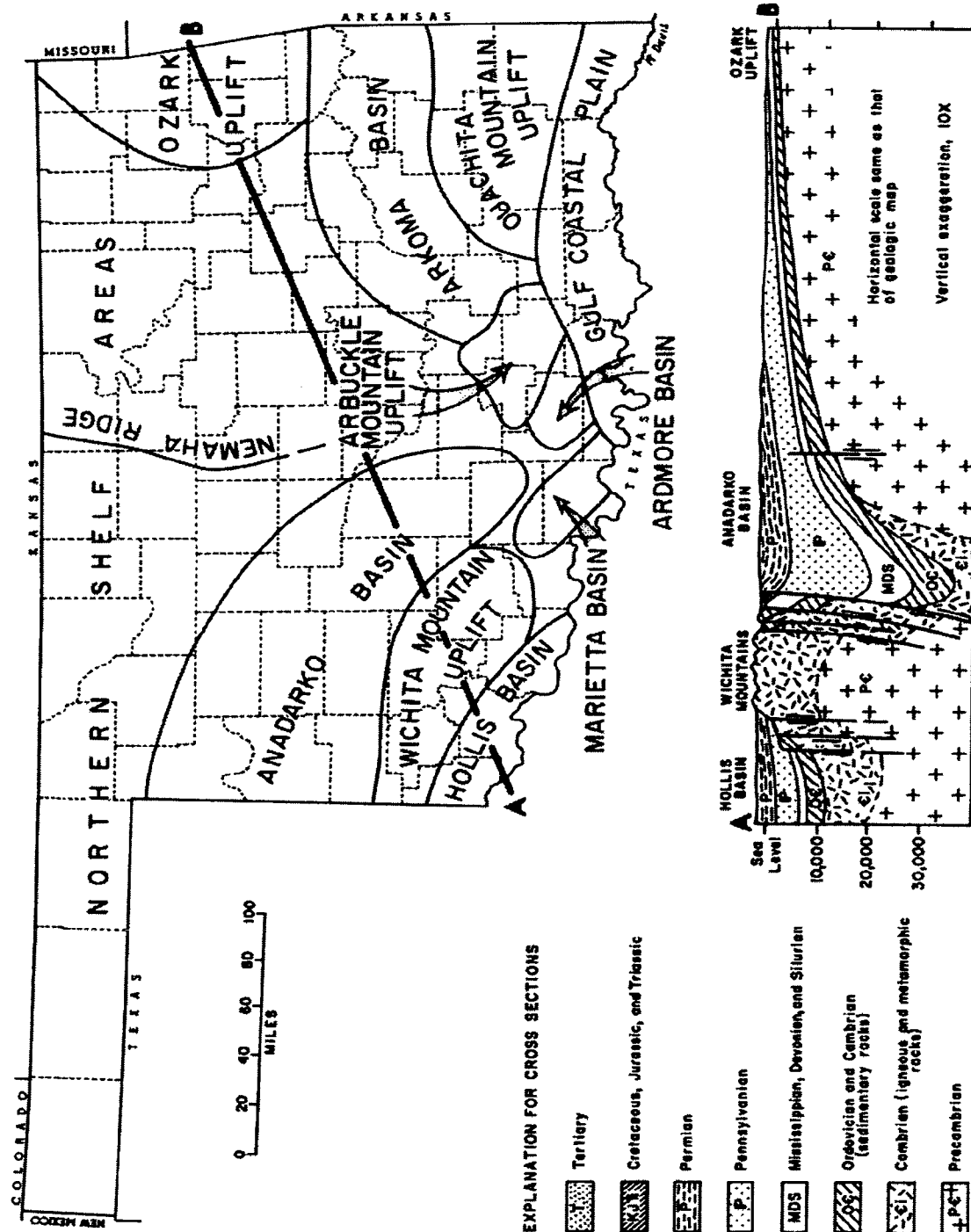


TABLE 9. ATLAS OF OKLAHOMA

State Population [*]	3,617,316
State Surface Area, Square Miles ^{**}	69,919
Number of Major Watershed Basins	7
Total Number of River and Stream Miles [*]	78,778
Number of Perennial River and Stream Miles [*]	22,386
Number of Intermittent Stream Miles [*]	55,413
Number of Canals or Ditches [*]	175
Number of River Border Miles ^{* **}	517
Total Number of Lakes/Reservoirs/Playa/Ponds ^{**}	224,948
Number of Large Lakes ^{**}	34
Number of Public & Private Lakes ^{**}	2,303
Number of Watershed Protection Lakes ^{**}	1,964
Number of Playa Lakes (wet season only) ^{**}	585
Number of Oxbow Lakes (≥ 10 Acres) ^{**}	62
Number of Farm Ponds (Soil Conservation Service assisted) ^{**}	220,000
Total Number of Lakes/Reservoirs/Playa/Ponds Acres ^{**}	1,041,884
Major Lake Acres ^{**}	555,450
Public & Private Lake Acres ^{**}	89,836
Watershed Protection Lake Acres ^{**}	54,261
Playa Lakes Acres ^{**}	9,572
Oxbow Lake Acres ^{**}	2,765
Farm Pond Acres ^{**}	330,000
Total Number of Freshwater Wetland Acres ^{***}	733,895

- ^{*} 2007 US Census Bureau Estimate
- ^{**} Based upon United States Geological Survey information
- ^{***} OWRB Data
- ^{*} Reach File 3/Digital Line Graph Data
- ^{**} Oklahoma Water Atlas, 1990
- ^{***} Estimates compiled from the Wildlife Department & U.S. Fish & Wildlife Service

Climate

Oklahoma has a continental type of climate. There are pronounced seasonal and geographical ranges in both temperature and precipitation. Average annual temperature varies from 53.6°F in the western part of the Panhandle up to 63.8°F in the southeast part of the state. Annual rainfall varies from approximately 17 inches in the far western part of the Panhandle to over 55 inches per year near the LeFlore County/McCurtain County/Arkansas border. The average growing season varies from 180 days in the Panhandle to 240 days in the southeast corner. Typically, 75% of Oklahoma's annual precipitation falls during the growing season.

Water Pollution Control Programs

The myriad and complex water quality problems remaining today require a more comprehensive approach to find workable and effective solutions. As we continue to have success reducing impacts from point sources, pollution from nonpoint sources takes on more significance. Non-traditional concerns such as habitat degradation and conservation of biological diversity also call for a comprehensive approach.

The watershed approach provides such a management framework. Utilizing support from the 104(b)(3) program, Oklahoma has taken the first steps to implement the watershed approach for water quality management in the state. The following accomplishments have been achieved:

- A Whole Basin Planning Approach Working Group was established to coordinate planning and implementation of the watershed approach in Oklahoma. Representatives of the various state and federal agencies with a role in water quality management were represented on the Working Group.
- A cooperative project with USGS produced a new digital elevation model and digital watershed maps for the state. Existing 8-digit cataloging units were subdivided into 11-digit watersheds. These watershed maps are the basis for the state program. The maps have been published on CD-ROM and are available to all agencies and the public.
- Utilizing the new watershed boundaries, the Working Group delineated 11 Watershed Management Units that are used to implement the watershed approach. The intent is that planning, monitoring, permitting, and other water quality programs will eventually be coordinated and organized at this scale when the watershed approach is fully implemented.
- Accurate locational data on all dischargers has been gathered using the Global Positioning System. These data have been built into a GIS-compatible format for analysis. Links to permitting and monitoring data in the PCS system have been established for analysis and assessment purposes.
- A technical committee was established to develop an implementation plan to utilize the new Watershed Management Units and watershed boundaries in the various reporting and planning programs. Water Quality Standards, the 303(d) list, the 208 Plan, and the 305(b) Report were targeted for this effort.

Water Quality Standards Program

Oklahoma's WQS are set forth under statutory authority of the OWRB authorized under 82 O.S. § 1085.30. Under these statutes, the OWRB "is required to set water quality standards which are practical and in the best public interest and to classify the state's waters with respect to their best present and future uses. These WQS are designed to enhance the quality of the waters, to protect their beneficial uses, and to aid in the prevention, control and abatement of water pollution in the State of Oklahoma" (OWRB, 2006). The WQS have established designated beneficial uses and standards for all of Oklahoma's waters.

Oklahoma defines waters of the state to mean "all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flow through, or border upon this state or any portion thereof 82 O.S. § 1084.2(3)."

Much of the work developing WQS over the past three decades has been dedicated to the control of point source discharges through chemical-specific criteria and permit limits. Over the past five years, biological water quality criteria have also been pursued.

Potential uses of biocriteria, as they pertain to Oklahoma's WQS, are numerous and far-reaching. Upon completion, biocriteria and their implementation procedures should be incorporated into the OWRB Rules and into Oklahoma's Continuing Planning Process (CPP) document. They should then be used as an assessment tool.

The current biological thresholds will allow state agencies and others to consistently analyze the biological community in terms of the Fish and Wildlife Beneficial Use. These procedures will, for the first time, allow for consistent examination of biological communities with a minimum of subjectivity and judgment. Ongoing work in this area of biocriteria development will eventually provide statewide coverage and a biological Use Support Assessment Protocols for all ecoregions in Oklahoma.

Candidate reference streams have been selected in the Ouachita Mountain, Arkansas Valley, Boston Mountains, Ozark Highlands, and Central Irregular Plains ecoregions. Previous work has determined reference taxa for these

ecoregions and these lists are currently being validated through thorough stream assessments. Following are details of the ecoregions listed above (OWRB, 2006):

Special provisions for Ouachita Mountains wadable streams.

The determination of whether the use of Fish and Wildlife Propagation is supported for wadable streams located in the Ouachita Mountains ecoregion shall be made according to the application of Appendix C of this Chapter, together with this subsection, as follows:

- (1) Where designated, the subcategory of Warm Water Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 35 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 24 or less. If a score is 25 to 34 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.
- (2) Where designated, the subcategory of Habitat Limited Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 27 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 18 or less. If a score is 19 to 26 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.

Special provisions for Arkansas Valley wadable streams.

The determination of whether the use of Fish and Wildlife Propagation is supported for wadable streams located in the Arkansas Valley ecoregion shall be made according to the application of Appendix C of this Chapter, together with this subsection, as follows:

- (1) Where designated, the subcategory of Warm Water Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 35 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 24 or less. If a score is 25 to 34 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.
- (2) Where designated, the subcategory of Habitat Limited Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 27 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 18 or less. If a score is 19 to 26 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.

Special provisions for Boston Mountains and Ozark Highlands wadable streams.

The determination of whether the use of Fish and Wildlife Propagation is supported for wadable streams located in the Boston Mountains and Ozark Highlands ecoregions shall be made according to the application of Appendix C of this Chapter, together with this subsection, as follows:

- (1) Where designated, the subcategory of Cool Water Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 37 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 29 or less. If a score is 30 to 36 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.
- (2) Where designated, the subcategory of Warm Water Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 31 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 22 or less. If a score is 23 to 30 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.

Special provisions for Central Irregular Plains wadable streams.

The determination of whether the use of Fish and Wildlife Propagation is supported for wadable streams located in the Central Irregular Plains ecoregion shall be made according to the application of Appendix C of this Chapter, together with this subsection, as follows:

- (1) Where designated, the subcategory of Cool Water Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 35 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 28 or less. If a score is 29 to 34 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.
- (2) Where designated, the subcategory of Warm Water Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 30 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 22 or less. If a score is 23 to 29 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.
- (3) Where designated, the subcategory of Habitat Limited Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 25 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 16 or less. If a score is 17 to 24 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.

Special provisions for Central Oklahoma - Texas Plains wadable streams.

The determination of whether the Warm Water Aquatic Community subcategory of the Fish and Wildlife Propagation beneficial use is supported for wadable streams located in the Central Oklahoma - Texas Plains ecoregion shall be made according to the application of Appendix C of this Chapter, together with this subsection, as follows:

- (1) Such subcategory shall be deemed fully supported if the application of Appendix C produces a score of 26 or more.
- (2) Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 19 or less
- (3) If the application of Appendix C produces a score of 20 to 25 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.

Special provisions for Central Great Plains wadable streams.

The subcategory of Warm Water Aquatic Community of the beneficial use of Fish and Wildlife Propagation in the wadable streams located in the Central Great Plains ecoregion shall be deemed fully supported if the application of Appendix C of this Chapter produces a score of 22 or more. Such subcategory shall be deemed not supported for the streams in the ecoregion of the application if the application of Appendix C produces a score of 18 or less. If the application of Appendix C produces a score of 19 to 21 inclusive, the issue of whether this subcategory is supported for the streams in this ecoregion shall be deemed undetermined. Provided, however, this subsection does not apply to the area bounded by State Highway 64 on the west, U.S. Highway 62 on the south, U.S. Highway 281 on the east and State Highway 19 on the north.

Oklahoma will be able to monitor biological communities to determine the effectiveness of permit limits and the parameter-specific criteria they are base upon. Incorporation of biological monitoring and biocriteria to evaluate fish and wildlife beneficial use support will help reduce monitoring costs by eliminating otherwise required tests for metals, pesticides, and other toxic substances.

Point Source Control Program

Oklahoma's point source pollution control programs are administered and carried out by the DEQ. The DEQ administers both municipal and industrial dischargers and issues permits. The DEQ is responsible for monitoring the dischargers to ensure compliance with permit limitations and conditions as well as to receive and review the permittee's self-monitoring data.

For industrial dischargers, the DEQ relies on a two-step process for permit development. In the first step, minimum treatment level standards, based on the industry type, are established. These are termed "technology-based limits." The technology-based limits are evaluated to determine if a potential exists to violate the WQS. If the potential exists to violate the WQS, then more stringent "water quality-based limits" will be selected for use in the permit.

Each permit specifies both monitoring and reporting requirements for the facility. The permit gives the effective dates of limits, parameters to be tested, applicable limits for each parameter, frequency of analysis, and sample type of monitoring. Monitoring results are summarized on a monitoring report form and submitted to the DEQ according to the schedule in the permit. All Discharge Monitoring Reports (DMR) and reports from the permittee are reviewed and violations noted. The permittee's compliance is tracked using the Permit Compliance System (PCS). The administrative staff utilizes violation review criteria to screen for significant violations. This screening process assures that limited enforcement resources concentrate on the most significant violations. The following criteria are used to identify significant violations:

- Two or more excursions of 40% or more for inorganic and oxygen demanding pollutants during a six-month period.
- Two or more excursions of 20% or more for toxic pollutants during a six-month period.
- Non-reporting violations.
- Chronic violations, any violation of any monthly effluent limit for any four or more months in a six month period.
- Any effluent violation that causes or has potential to cause a water quality or human health problem.
- Permit schedule violations.
- Violations of enforcement orders
- Any unauthorized bypass, unpermitted discharge, or pass through of pollutants which may cause a water quality or human health problem.
- Construction or modification of sewage treatment works, Publicly Owned Treatment Works conveyance system or industrial wastewater impoundment, without a permit.

The criteria used for determining significant violations are based on the EPA's current policy, which is used to evaluate all major and minor permits under the DEQ's jurisdiction.

Quality assurance strategies are used by the DEQ to ensure that facilities comply with their permit. Field inspections are conducted on a regular basis with samples of the discharge collected for analyses. The Customer Assistance Division maintains the laboratory certification program. This program assures that industries follow all Quality Assurance and Quality Control methods when analyzing their effluent samples. All permits require that all analyses used to determine permit compliance be performed by a DEQ certified lab.

The limits for the permits are "water quality based" and are designed to protect the beneficial uses of the receiving stream. All permits are tracked through the state's Water Quality Management Plan. The plan is updated as needed. The updates to the Plan occur on a regular basis with the last full annual update to the Plan being in 1984.

Each permit is written for a single facility. Most facilities have only one discharge; however, some do have multiple discharges. The information found in each permit includes: latitude and longitude for the facility and/or its point of discharge; effective date(s) of the permit; limits; self-monitoring frequency and sampling type for each discharge point; etc. In addition, the permit also requires the permittee to prepare and submit monthly Discharge Monitoring Reports, which give a summary of the results of the self-monitoring. The Discharge Monitoring Reports are submitted to DEQ.

All Discharge Monitoring Reports from the permittee are reviewed with violations being noted. The permittee's compliance is then tracked using the PCS (an EPA computer database system). The DEQ screens the DMR for significant violations. This screening process allows the DEQ to concentrate its funding where it is needed most.

Quality Assurance/Quality Control practices are used by the DEQ to ensure that publicly owned treatment works are complying with permit conditions. Regular inspections of publicly owned treatment works facilities are conducted by the DEQ and/or the EPA inspectors with samples of a facility discharge collected for analysis. The DEQ requires that all operators and laboratory technicians of publicly owned treatment works be properly trained and certified.

Nonpoint Source Control Program

The OCC serves as the lead technical agency for the nonpoint source (NPS) control program except for oil and gas activities and petroleum storage tanks, which are under Corp. Comm. jurisdiction. The NPS program is a cooperative effort of state, federal and local agencies. Some of these agencies include the OCC, the DEQ, the ODAFF, the OWRB, Corp. Comm., local conservation districts, and local landowners. The management programs identify the state, federal and local agencies with responsibilities relative to the nonpoint source of pollution in question and outline a plan of action to reduce or eliminate those sources.

The 2000 revision of the NPS Management Program document includes an inventory of best management practices available for controlling NPS pollution. There are two basic classes of Best Management Practices (BMPs): 1) practices that reduce the pollutants available for transport by the normal rainfall/runoff process (management practices), and 2) devices that reduce the amount of pollutants in the runoff before it is discharged to a surface water body (structural practices). The two main categories of BMPs can be broken down into the following seven general categories:

1. Detention Basins -- The term detention applies when the runoff is temporarily stored, and apart from relatively minor incidental losses due to evaporation or percolation, is subsequently discharged to surface water. Control results from a reduction in pollutant concentrations due to settling during the period that the runoff is detained.
2. Retention Devices -- The term retention applies when runoff is permanently captured so that it is never discharged directly to surface water. The usual mechanism by which storm-water controls permanently capture surface runoff is by infiltration. These techniques are often referred to as infiltration BMPs.
3. Vegetative Controls -- Vegetative controls provide contact between storm-water runoff and vegetated areas and accomplish pollutant removal by combination of filtration, sedimentation and biological uptake that reduce pollutant concentrations, and/or by a reduction in runoff volume due to infiltration or evapotranspiration. Vegetative controls are particularly effective in reducing erosion from runoff across disturbed sites or road bar ditches.
4. Source Controls -- Source control techniques include any practice that either 1) reduce the amount of accumulated pollutants on the land surface available for runoff by rainfall, or 2) regulate the amount of impervious area to reduce the portion of rainfall that will appear as runoff, or 3) exclude inappropriate discharges to storm drains.
5. Discharge Management -- This BMP category refers specifically to the hydrostructure/tailwater category. Under this BMP, impoundment discharge is managed so that the power of discharge water is kept to a minimum and the quality of water is kept at a maximum. This includes aeration of tailwater or, other measures that increase dissolved oxygen levels in tailwater areas.
6. Grade Stabilization -- Grade stabilization refers to any of several different practices used to stabilize areas where rapid runoff of storm-water results in erosion. These can be either temporary or permanent and are generally used in drainage ways where the slope exceeds five percent.
7. Stream Bank Protection -- Stream bank protection refers to the practices used to maintain banks by preventing bank scouring, caving, and gullyng. This category includes stream channel stabilization and in-stream structure for water quality control.

The OCC will perform pre- and post-implementation monitoring to gauge the success of its projects.

The OCC is working toward solving the nonpoint source pollution problems in the watersheds of Lake Eucha, Illinois River, and Wister Lake, in cooperation with several agencies, including Corporation Commission, the ODAFF, the Scenic Rivers Commission, DEQ, the OWRB, INCOG, ACOG, the Cooperative Extension Service, the NRCS, and the

Agricultural Stabilization and Conservation Service. The project objectives are to 1) implement BMPs in those watersheds 2) demonstrate control measures to decrease nutrient loading in the watershed, 3) transfer information from successful demonstration projects to other watersheds, and 4) create a management program to coordinate all aspects of watershed remediation.

The OCC is the state agency that oversees implementation of the new Conservation Reserve Enhancement Program (CREP) signed April 23, 2007. CREP is a \$20.6 million cooperative conservation partnership agreement between USDA and Oklahoma. The program pays eligible landowners in eligible watersheds to establish areas of riparian buffers along streams, removing those strips of land from agricultural production for at least 15 years. Focused in northeast Oklahoma, CREP will create 500 acres of vegetative filter strips and 8,500 acres of riparian buffers for a total of 9,000 acres (or 370 miles) of protected streams. The conservation plantings will reduce the flow of nutrients, sediment and other pollutants in the Spavinaw Lake and Illinois River/Lake Tenkiller watersheds. Key CREP partners also include City of Tulsa's Metropolitan Utility Authority, Oklahoma Scenic Rivers Commission, conservation districts of Adair, Cherokee, Delaware, Mayes, and Sequoyah counties, the USDA Farm Service Agency (FSA) and USDA Natural Resources Conservation Service (NRCS).

The ODAFF has authorities under the Oklahoma Confined Animal Feeding Operation and Poultry Registration Acts to enforce regulations governing the owners and/or operators of concentrated confined animal feeding operations. This Act requires all animal wastes and wastewaters from such operations be held in a total retention system preventing its discharge to the waters of the state and that waste generated in these operations be disposed of in a proper manner. This Act was designed to prevent and abate pollution from entering and contaminating any surface or groundwater. Under this Act, the ODAFF is required to conduct inspections of these operations as well as investigate any complaints filed against such operations. The ODAFF can take regulatory action against a violator as deemed necessary.

The ODAFF has authorities under the Oklahoma Fertilizer Law to enforce the proper handling and storage of commercial fertilizers. The ODAFF licenses all bulk fertilizer storage facilities. All fertilizer materials shall be stored, applied, and handled in a manner, which prevents pollution of groundwater by minimizing losses of the fertilizer materials. This law is designed to prevent and abate the pollution of surface and groundwater within the state. Under this law, the ODAFF has the authority to conduct routine inspections of bulk storage facilities as well as investigate complaint received on a facility. The ODAFF can take regulatory action against a violator as deemed necessary.

The ODAFF has authorities under the Oklahoma Pesticide Applicator Law and the Oklahoma Pesticide Law to enforce the proper handling, storage, and use of commercial pesticides. These laws give the ODAFF authority to mandate regulations for the use of pesticides, how they are to be stored, and who can purchase them for application. These laws are designed to prevent or abate pollution of the waters of the state. Under these laws, the ODAFF must conduct routine inspections and investigates complaints on all facilities or individuals who store, sell, or apply pesticides. The ODAFF can take regulatory action against a violator as deemed necessary.

The ODAFF is also funding a yearly program to collect and properly dispose of unwanted pesticides. All Oklahoma farmers, ranchers, pesticide dealers, commercial applicators and non-commercial applicators are eligible to participate in this program. The ODAFF has contracted a licensed hazardous waste company to collect and properly dispose of waste pesticides in Oklahoma.

Corp Comm has worked with the Integrated Petroleum Environmental Consortium (IPEC), a consortium of the University of Tulsa (TU), the University of Oklahoma (OU), Oklahoma State University (OSU), and the University of Arkansas (UA) at Fayetteville, and the Marginal Well Commission to develop and disseminate best management practices for the hundreds of small oil and gas operators in the state. IPEC and Well Commission meetings and workshops, along with the brochures, checklists, kits, videos, and other materials provided by IPEC, have helped producers reduce the environmental impacts from their oil and gas activities. In addition, Corp Comm has adopted and enforced rules on site operation, pollution containment BMPs, land application, and spill cleanup with site restoration that help to minimize non point source impacts.

There are other nonpoint source projects that affect either a specific watershed area, or are statewide projects that will affect several waterbodies. In addition, there are projects planned in other areas of concern other than agriculturally related problems. Continuation of this program is dependent largely on federal grant support.

Superfund Program

Historical hazardous waste problems did not fit into the regulatory hazardous waste system until the passage of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund) of 1980. This act created a large scale national program to identify and clean up sites contaminated from historical hazardous waste problems and whose owners were no longer available or financially solvent to pay for the clean up, or whose owners were no longer around. The term "Superfund" was coined to describe the source of funding for this program. Funding for remedial action was initially obtained from a national revolving fund. The fund obtained its monies through taxes paid on chemical feedstocks used in the manufacture of chemical products that are likely to become hazardous waste. This fund has not been reauthorized since 1996 and funding now relies on general appropriations by Congress. Superfund also established a mechanism to recover cleanup costs from potentially responsible parties.

The DEQ's Superfund Program conducts and oversees pre-remedial and remedial activities on several Superfund sites. The Oklahoma Superfund Program relies on federal monies awarded through a cooperative agreement with EPA. There are thirteen sites in Oklahoma that are on the EPA National Priority List (NPL). EPA ranks sites for clean up based on the actual or potential risks posed to human or the environment.

The DEQ's Voluntary Cleanup Program and Brownfield Redevelopment Programs have several large Superfund-like sites that are undergoing investigation and cleanup. In addition to these larger sites the Voluntary Cleanup Program has dozens of sites that are undergoing remediation for ground water contamination. There are also many RCRA sites that are undergoing corrective action for ground water contamination that are not listed here.

The DEQ also has authority under 27A O.S. §2-7-123 for risk based remediations, and/or 27A O.S. §2-15-107 for Brownfields sites to place notices on property deeds of risk-based remediation and also allows for restrictions on certain uses, including ground water if appropriate. Some of the sites listed below have such notices and restrictions filed in their respective county office.

Refer to Table 10, "Superfund, NPL, and Non-NPL Sites Impacting on Groundwater and Surface Water" for a listing of sites within Oklahoma.

TABLE 10. SUPERFUND, NPL, AND NON-NPL SITES IMPACTING ON GROUNDWATER AND SURFACE WATER

Sites	Legal	County	Contaminant of Concern	Groundwater Impacted (Yes/No)	Surface Water Impacted (Yes/No)
Tar Creek Mining Activities	R24E T29N S16-21 R24E T29N S29-32 R24E T28N S5-6 R23E T28N S05-08 R23E T28N S18-19 R23E T28N S30 R23E T29N S13-36 R22E T28N S01 R22E T28N S12-13 R22E T28N S24-25 R22E T28N S30 R22E T29N S13 R22E T29N S24 R22E T29N S25 R22E T29N S36	Ottawa	Acid Water Cadmium Iron Lead Sulfates Zinc	Boone Aquifer Yes Roubidoux Aquifer, yes (locally near Picher and Quapaw)	Tar Creek Yes

Sites	Legal	County	Contaminant of Concern	Groundwater Impacted (Yes/No)	Surface Water Impacted (Yes/No)
Sand Springs Petrochemical Complex Refinery/ Solvent Recycling	R11E T19N S13-14	Tulsa	Volatile Organic Compounds	Arkansas River Alluvium Yes	Arkansas River (receives discharges but no identifiable impacts)
Compass Municipal Landfill	R12E T19N S18	Tulsa	Benzene Bleaches Caustics Jet Fuel PCBs Pesticides Solvents	Not Applicable	Arkansas River No
Hardage-Criner Industrial Landfill	R04W T06N S24	McClain	Acids Alcohols Caustics Metals Pesticides Solvents	North Criner Creek Alluvium Yes	North Criner Creek Yes
Tenth Street Salvage Yard	R02W T12N S31	Oklahoma	PCBs	North Canadian Alluvium No	North Canadian River No
Tinker AFB Aircraft Maintenance	R02W T11N S14 R02W T11N S23	Oklahoma	Organic Solvents (TCE) Chromium Petroleum Fuels	Garber-Wellington Aquifer Yes	Soldier Creek Yes
Fourth Street Refinery	SE4 SEC35 T12N R3W & SW4 SEC36 T12N R3W	Oklahoma	Lead BTEX Volatile Organic Compounds	Garber-Wellington Aquifer Yes North Canadian Alluvium Yes	North Canadian River No identifiable impacts
Mosley Road Landfill Municipal Landfill	R02W T12N S21	Oklahoma	Volatile Organic Compounds	Garber-Wellington Aquifer Yes North Canadian Alluvium Yes	North Canadian River No

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Sites	Legal	County	Contaminant of Concern	Groundwater Impacted (Yes/No)	Surface Water Impacted (Yes/No)
Double Eagle Refinery Refinery	SE4 SEC35 T12N R3W & SW4 SEC36 T12N R3W	Oklahoma	Lead BTEX Volatile Organic Compounds	Garber-Wellington Aquifer Yes North Canadian Alluvium Yes	North Canadian River No
Oklahoma Refining Co Refinery	R09W T05N S18-19	Caddo	Metals VOCs Petroleum Organics Aromatic Hydrocarbons	Rush Springs Aquifer Yes	Gladys Creek Yes
Kerr-McGee Cushing Refinery Refinery	R05W T18N S22&27	Payne	Acid Oil Sludge Heavy Hydrocarbons	Unconfined Aquifer Yes Vamoosa-Ada Aquifer No	Skull Creek Yes
Kerr-McGee Cleveland Refinery Refinery	R08E T21N S18	Pawnee	Petroleum Coke Asbestos Acid Sludges	Cedar Creek Alluvium Yes Vamoosa-Ada Aquifer Yes	Cedar Creek Yes
Blackwell Zinc Smelter	R01W T27N S21	Kay	Metals	Chikaskia River Alluvium Yes	Unnamed tributary of Chikaskia River Yes
National Zinc	R12E T26N S11	Washington	Metals	Not Applicable	Unnamed tributary of Eliza Creek Cleaned up
Federated Metals Smelter	R11E T19N S10	Tulsa	Metals	No	No
Tulsa Fuels & Manufacturing Smelter	NE4 SE4 NE4 SEC 31 & SW4 NW4 SEC32 T22N R14E 1M	Tulsa	Metals	No	Unnamed drainages Yes (sediment only)

Sites	Legal	County	Contaminant of Concern	Groundwater Impacted (Yes/No)	Surface Water Impacted (Yes/No)
Hudson Refining Refinery	SW4 SEC33 T18N R05E & NE4 NW4 SEC04 T17N R05E 1m	Payne	Hydrocarbons metals	Vanoss Aquifer Yes	Wastewater Ponds On-Site Yes Skoll Creek No
Duncan Refinery Refinery	R7W T1S S32	Stephens	Hydrocarbons	Garber Yes	Claridy Creek Yes
Collinsville Smelter Smelter	R14E T22N S32	Tulsa	Metals	No	Blackjack Creek Yes (sediment only)
U.S. Zinc Company Smelter	R13E T11N S6	Okmulgee	Metals	No	Yes
Coltec, Inc. Manufacturing	R13E T11N S3	Sequoyah	Solvent (PCE)	Boggy Formation Yes	No
Rab Valley Lumber	R25E T8N S15, S16	LeFlore	PAHs	Yes	Yes
Union Pacific Railroad	R7W T17N S14	Kingfisher	Carbon Tetrachloride	Yes	No
Okmulgee Refinery	R13E T13N S31 R13E T12N S6	Okmulgee	BTEX, Metals, PAHs	Yes	Yes
Imperial Refining Corporation	R2E T4S S20, S21	Carter	BTEX, Metals, PAHs	No	Wetlands Yes
Clinton-Sherman Industrial Airpark Airbase	R19W T10N S10-11 R19W T10N S14-15	Washita	Trichloro- ethane (TCE)	Elk City Sandstone Aquifer Yes	Not Applicable

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Sites	Legal	County	Contaminant of Concern	Groundwater Impacted (Yes/No)	Surface Water Impacted (Yes/No)
Dobson Ranch	NW4 SEC 17 T11N R26W IM	Roger Mills	Benzene	Ogallala Yes	No
Cornerstone Shopping Center	SE4 SEC16 T 12N R 4W approx 6 acres of West Park Addition to Oklahoma City	Oklahoma	Tetrachloroethene	Quaternary Terrace Deposits Yes	No
Oklahoma City Urban Renewal - Phase I	21.6 acres of the NW4 SEC 3 T11N R3W	Oklahoma	Hydrocarbons	Alluvium and Terrace Deposits Yes	No
Blackstar Performance	SE4 SEC25 T20N R8E & NE4 SEC25 T20N R8E	Pawnee	Chlorinated solvents	Tallant Formation Yes	No
OKC Solvent Plume	80 acres in NE/4 S27 T12N R4W & NW/4 S27 T12N R4W	Oklahoma	Chlorinated solvents	N. Canadian Terrace Deposits Yes	No
Compass Industries Landfill	R12E T9N SEC18 & NE4 SE4 SEC 13 T 19N R 11E	Tulsa	SVOC	Yes	Yes

Sites	Legal	County	Contaminant of Concern	Groundwater Impacted (Yes/No)	Surface Water Impacted (Yes/No)
Anadarko Petroleum	NW1/4 Sec4 T22N R6W	Garfield	Petroleum Hydrocarbons and metals	Yes (Terrace Deposits)	No
Michelin/BFG	N1/2 SW1/4 T28N R22E	Ottawa	VOC	Yes	No

Cost/Benefit Assessment

Costs

The citizens of this state demand a safe environment in which to live. We take for granted the availability of clean, safe, adequate drinking water, clean air, inexpensive and convenient solid waste disposal, adequately maintained wastewater treatment facilities, and an aesthetically pleasing natural environment for recreation.

The mechanisms for providing a clean and safe environment are divided among the federal, state, and municipal/local governments. It is therefore difficult to obtain an accurate estimate of the cost of water pollution control efforts. However, a portion of the costs of water pollution control, on an annual basis, can be obtained by looking at funding received under the CWA. Table 11 provides this information for currently active grants.

TABLE 11. FEDERAL CLEAN WATER ACT AND STATE MATCHED FUNDING FOR CURRENTLY ACTIVE GRANTS

GRANT NAME	AWARD AMOUNT	STATE SHARE	TOTAL
05 604 (b)	\$100,000	\$0	\$100,000
06 604 (b)	\$100,000	\$0	\$100,000
07/08 604(b)	\$ 200,000	\$0	\$200,000
03 319 (h)	\$3,677,000	\$2,451,333	\$6,128,333
04 319 (h)	\$3,639,800	\$2,426,533	\$6,066,333
05/06 319 (h)	\$6,299,900	\$4,199,933	\$10,499,833
07/08 319(h)	\$ 7,691,800	\$5,127,867	\$12,819,667
03 Wetlands	\$215,180	\$71,726	\$286,906
05 Wetlands	\$379,524	\$126,510	\$506,034

GRANT NAME	AWARD AMOUNT	STATE SHARE	TOTAL
06 Wetlands	\$186,600	\$62,200	\$248,800
07 Wetlands	\$310,796	\$158,528	\$469,324
08/09 106	\$2,934,637	\$271,544	\$3,206,181
05 104 (b)(3)	\$199,500	\$10,500	\$210,000
05 104 (b)(3)	\$61,640	\$3,244	\$64,884
03 104 (b)(3)	\$247,955	\$13,050	\$261,005
04 104 (b)(3)	\$253,758	\$13,355	\$267,113
05 104 (b)(3)	\$304,000	\$16,000	\$320,000
07 104(b)(3)	\$150,000	\$149,956	\$299,956
06 Title VI State Water Pollution Control Revolving Loan Fund	\$7,046,300	\$1,409,260	\$8,455,560
Totals	\$33,998,390	\$16,511,539	\$50,509,929

Table 12 Lists projects funded through the Clean Water SRF loan program for construction of new wastewater treatment and collection system projects and rehabilitation or upgrades for fiscal years 2006 & 2007. Total assistance amounts listed represent funds committed to projects upon loan closing or final project costs, which are determined upon project completion and may vary slightly.

TABLE 12. FY 2006-2007 MUNICIPAL WASTEWATER TREATMENT CONSTRUCTION PROJECTS FUNDED THROUGH THE CLEAN WATER STATE REVOLVING FUND

COMMUNITIES SERVED	PROJECT NUMBER	ASSISTANCE AMOUNT	FISCAL YEAR OBLIGATIONS	BINDING COMMIT DATE	FEDERAL FUNDS	NON-FEDERAL FUNDS
Broken Arrow MA	ORF-05-0006-CW	\$15,000,000	06	06/20/06	12,450,000	2,550,000
Glencoe PWA	ORF-05-0003-CW	\$170,000	06	12/13/05		\$170,000
Pauls Valley MA	ORF-04-0013-CW	\$900,000	06	09/13/05		\$900,000
Noble UA (Ref.)	ORF-06-0004-CW	\$2,540,000	06	03/14/06		\$2,450,000
Sand Springs MA	ORF-05-0010-CW	\$2,250,000	06	05/10/05	\$1,867,500	\$382,500
Stroud UA	ORF-05-0004-CW	\$1,683,385.26	06	08/09/05		\$1,683,385.26
Tishomingo MA	ORF-04-0003-CW	\$1,115,000	06	10/11/05		\$1,115,000
Tulsa MUA	ORF-05-0009-CW	\$3,130,000	06	02/14/06	\$2,597,900	\$532,100
Beggs PWA	ORF-05-0005-CW	\$2,170,000	07	03/13/07		\$2,170,000
Collinsville MA	ORF-06-0009-CW	\$1,370,000	07	02/13/07		\$1,370,000
Hobart PWA	ORF-06-0005-CW	\$950,000	07	03/13/07		\$950,000
Lawton WA	ORF-07-0003-CW	\$10,420,000	07	06/12/07	\$8,648,600	\$1,771,400
McCloud PWA	ORF-04-0008-CW	\$5,315,000	07	10/10/06		\$5,315,000
Tulsa MUA	ORF-06-0006-CW	\$17,825,000	07	10/10/06	\$14,794,750	\$3,030,250
Woodward MA	ORF-07-0001-CW	\$1,400,000	07	06/12/07	\$1,162,000	\$238,000

Benefits

Authorized under CWA Section VI, Oklahoma's Clean Water State Revolving has received an average of \$10.8 million in federal grant funds annually and has provided an average of \$28.5 million annually in water pollution control financing since 1990. This program enables eligible public entities to receive low-interest financing for water pollution control activities, including construction of treatment works and urban storm water runoff projects, and nonpoint source pollution control activities. Through FY 2007 the Clean Water State Revolving Fund has provided over \$513 million for 132 construction projects which support the fishable/swimmable goals of the Clean Water Act, assist the State in maintaining water quality standards, and protect and improve waters of the State.

With a 2.32-to-1 return on federal investment at the end of FY 2007, this program provides a renewable source of financing for Oklahoma's ever-increasing water pollution control funding gap, as repayments of these loans, combined with federal and state funds, investment income, and revenue bonds, are recycled to finance future projects. The program's "60%-of-market" fixed interest rate has saved communities an estimated \$170 million in interest savings from program inception through July 2007.

Prior to the formation of the DEQ, the Pollution Control Coordinating Board had been assessing claims for wildlife or fish kills caused by known spills of pollutants. The Wildlife Department has and continues to use values set by the American Fisheries Society for assessing dollar amounts for all fish and/or wildlife kills. In most cases, the entity or responsible party(ies) pays the state for all damages.

One of the primary concerns for the state is the identification and quantification of water quality problems associated with nonpoint source pollution. The sources can be erosion of stream banks yielding excess sedimentation to streams and lakes, runoff from over fertilized croplands or pastures, runoff from lawns containing pesticides and fertilizers, and street runoff containing oil and grease. In addition, Oklahoma is now one of the top states in poultry and swine production, which have grown to become Oklahoma's second and third largest agricultural industries, respectively. There is concern regarding the generation of waste and its management. The nonpoint source Chapter describes some of the demonstration projects that are addressing these concerns. The agricultural and silvicultural nonpoint source management components required for 319 grant funding have been developed, approved by the EPA and implementation has begun. Additional management program components covering broader areas of concern have been developed and are currently under review. Once these management program components are approved, additional implementation projects can be started.

However, nonpoint source pollution should not be automatically attributed to agricultural activities, as there are many sources that contribute to nonpoint source pollution. Other nonpoint source concerns include: acid mine drainage impacts on surface and groundwater, runoff from oilfield activities, abandoned refineries, rural roads, hydrostructure tailwaters, in-place contaminants (i.e. underground storage tanks), industrial parks, on-site wastewater disposal systems, pollutants associated with recreation, and the effects of urban runoff.

Oklahoma has an active Wellhead Protection Program and the state has performed and is performing delineation of Wellhead Protection Areas for several municipalities. As a priority for the future, the state realizes the need to work closely with the municipalities to carry out source inventory surveys and assist with management and contingency plans for their groundwater based drinking water supplies.

The state has had a Water Quality Management Plan for several years, although it has been several years since its last update. Another of the state's priorities for the future is to develop an innovative and workable Water Quality Management Plan.

Many of the problems associated with point sources of pollution have been addressed through the National Pollutant Discharge Elimination System. As a result, the majority of point source dischargers has been identified and is monitored for permit compliance. The DEQ is working on refining its Total Maximum Daily Load process. This process will enable the state to better address pollution problems while permitting future growth of industry.

In order to obtain a better picture of the water quality of the state, Oklahoma and EPA should seek to increase funding for monitoring. In point of fact, monitoring in Oklahoma should be increased in order to meet the data needs of the various governmental entities. If our waters are to be managed in an effective and efficient manner it is essential that adequate amounts of good quality data be available to scientists and decision makers.

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Surface Water Assessment

Surface Water Monitoring Program

The two agencies primarily responsible for carrying out Oklahoma's surface water monitoring programs are the OCC and the OWRB.

Brief Summary of Oklahoma Conservation Commission Monitoring Activities

The Oklahoma Conservation Commission Water Quality (OCCWQ) Program conducts five major kinds of monitoring across the state. Following is a summary of these activities.

1. **Ambient Monitoring**
 - a. Routine monitoring at fixed (Rotating Basins Monitoring Program) or randomly selected sites. RB program monitoring is conducted on a rotational basis such that sites are monitored for 24 months every five years.
 - b. Identification of the magnitude, effect(s), and potential source(s) of nonpoint source pollution in the waters of the state.
 - c. Includes collection of physical, chemical, and biological data.
 - d. Fulfillment of the Clean Water Act Section 319 mandate, "to monitor and assess the State's waters for the effects of NPS pollution."
2. **Diagnostic Monitoring**
 - a. Usually occurs subsequent to ambient monitoring
 - b. Involves more in-depth sampling to confirm or refute suspected problems, identify and pinpoint sources, and more accurately document causes and effects of specific problems
 - c. May include land use assessment, modeling, intensive water quality monitoring, and biological assessments
3. **Implementation Monitoring**
 - a. Designed to determine the effects of best management practices (BMPs) on water quality
 - b. Often involves sampling before and after a management practice is installed
 - c. May include physical, chemical, and/or biological assessments and may involve collections via automated sampling devices.
4. **Reference Condition Monitoring**
 - a. Designed to determine what conditions a healthy waterbody should exhibit in order to determine if other waterbodies are polluted, and to what extent
 - b. Data collection includes measuring native plant communities, geology and soils, slope, climate, other factors related to geography, and resident communities of aquatic organisms
 - c. As the reference data is collected and compiled, a more complete picture of reference conditions is established which will lead to a reduced need for reference monitoring
 - d. Reference monitoring data will be used by the OWRB to help establish biological criteria as part of state water quality standards
5. **Volunteer Monitoring**
 - a. Statewide volunteer monitoring program designed to provide a continuing opportunity for water quality and environmental education.
 - b. Volunteers are trained and certified for collection of select physical, chemical, and biological data used for basic assessment and general trend monitoring

The OCC conducts other specialized types of monitoring, although rather infrequently and generally at the request of other agencies. Purposes for monitoring may include:

- Probabilistic based monitoring
- Protection of endangered species

- Total maximum daily load (TMDL) development
- Fluvial geomorphology (establishing the relationship between stream shape, climate, and the stream's location in the watershed)

All OCCWQ monitoring is conducted in accordance with EPA-approved Quality Assurance Project Plans (QAPPs). These QAPPs are subject to peer agency review and approval by the Office of the Secretary of the Environment. OCCWQ monitoring efforts are coordinated with other state and federal environmental agencies in order to maximize the use of state resources.

Brief Summary of Oklahoma Water Resources Board Monitoring Activities

OWRB conducts routine monitoring throughout the state. The major monitoring program is the Beneficial Use Monitoring Program (BUMP) out of which an annual report is generated and distributed to all State legislators. BUMP targets sites on lakes and streams in cooperation with DEQ, OCC, and other state agencies. Parameters are selected in order to establish the overall health of state waters and to discover ambient trends, develop TMDLs, and support development of water quality standards. The primary purpose of the BUMP is to assess the beneficial use support status of state surface waters.

OWRB also manages a statewide volunteer monitoring program called Water Watch. Samples are analyzed to determine overall trends and must meet data quality objectives outlined in the Water Watch Quality Assurance Project Plan.

In addition to BUMP and Water Watch, OWRB conducts several special monitoring efforts across the state. Parameters, sites, and frequency of monitoring are established on a case-by-case basis for each of these programs. All are established under formal contracts with the various entities.

- Clean Lakes & Technical Studies
 - Eucha & Spavinaw Lakes
 - Monitoring to assess impact of nutrients
 - Establish long-term monitoring plan
 - Determine target nutrient concentration to address taste & odor problems
 - Oklahoma City PWS Lakes
 - Conduct water quality and bathymetric measurements
 - Determine health and water quality trends
 - Includes OKC's six public water supply lakes and the North Canadian River
 - Wister Lake – project complete
 - Low-cost restoration pilot project
 - Focused on aquatic plant establishment and reduction of wave action
- Biological Assessments
 - Aimed at establishing biological criteria for inclusion in the Water Quality Standards
 - Combines physical, chemical, and biological measurements in a holistic approach
- Impaired Waterbody Monitoring – 303(d) List
 - Site-specific monitoring under various contracts with DEQ, OCC, and Oklahoma Corporation Commission
 - Aimed at verifying impaired waters listings and/or developing TMDLs

All monitoring activities are coordinated with the other state and federal agencies that collect water quality data in order minimize duplication of efforts.

Brief Summary of Oklahoma Corporation Commission Monitoring Activities

The Corporation Commission (Corp Comm) does five types of environmental monitoring:

1. Soil sampling at spill and other potential pollution case sites;

2. Well water sampling near spill and other potential pollution source sites (ground water impacts are discussed in the Ground Water Quality section, page ...);
3. Stream water sampling near spills, pits, purging wells, and other potential pollution sources;
4. Stream, and other surface water sampling in historic oilfield areas, to determine the overall impact of historical oilfield activity on the waters of the state; and
5. Sampling to evaluate the need for and propose watershed-specific revisions to surface water quality standards.

Both the Petroleum Storage Tank and the Oil and Gas Conservation (Oil & Gas) Divisions within the Oklahoma Corporation Commission perform the first three types of sampling. Only Corp Comm Oil & Gas does the types of sampling listed in 4 and 5. These were partially grant (104b, 319h) funded but mostly state funded until 2005, when Corp Comm Oil & Gas, with assistance from the Oklahoma Conservation Commission, began an extensive grant-funded sampling and source identification project in several old oilfield areas with high salinity produced water in South-Central Oklahoma. The descriptions below cover only Oil and Gas Division water quality monitoring.

- A. Since 1998 the Oil and Gas Conservation Division has been performing and working with partners on the type of sampling listed in items 3 and 4 above. Overall, the number of sites sampled so far to determine stream water quality in oil and gas producing areas is:

- 5310 surface water sampling events to evaluate overall stream quality, and
- 1229 stream sample events in old oil fields in relation to nearby spills

This total includes 1,370 samples (approximately 10 per stream) collected and analyzed for Corp Comm Oil & Gas under the OWRB's Rotating BUMP program, and 1810 completed sampling events (plus 1045 dry/no access attempts) done by Conservation Commission personnel and paid for by Corp Comm Oil & Gas under the South Oklahoma 104b grant. The rest of the samples were state funded, collected by Corp Comm Oil & Gas personnel. Corp Comm Oil & Gas has been evaluating the analysis results to determine which of the monitored streams are actually impaired, and which are attaining some or all of their designated beneficial uses. A visual check for petroleum is made every time a stream is sampled.

- B. In addition to the sampling listed above, in 2002 and 2003 Corp Comm Oil & Gas oversaw a project to gather typical mineral levels in streams in several watersheds. Corp Comm hoped to use this data, combined with other stream data already collected, to help determine appropriate watershed-based state water quality standards in several areas across the state. Conservation Commission staff collected most of the water samples, with Corp Comm Oil & Gas paying for the analyses with a small 104b grant and managing the data.. This includes
- 373 samples from approximately 90 streams in 25 watersheds collected by Conservation Commission and analyzed with Corp Comm Oil & Gas's funds;
 - 87 BUMP samples collected in multiple streams for Corp Comm by OWRB in one additional watershed.
- C. From 2005 until 2008 Corp Comm has worked on the South Central Oklahoma Project in a 33X33 mile area (over 1000 square miles) in Grady, Garvin, Stephens, and Carter counties. For 18 months every accessible location where a stream crossed a road was periodically sampled by Oklahoma Conservation Commission personnel using calibrated field meters for pH, TDS, and conductivity. In 337 of the 1810 water monitoring events water samples were also collected and sent to a lab for complete analysis of all anions and cations. This data was used to determine that 59 permanently flowing streams and smaller tributary creeks in the old oilfield areas evaluated had significantly elevated salinity levels. A Helicopter EM survey was also done in part of this area to determine groundwater impacts and surface water/groundwater interaction – see the Groundwater Quality section of this report for more detail.
- D. The sampling results from all of the different surface water sampling projects, plus some limited data provided to Corp Comm by others (e.g. 44 samples collected by the University of Tulsa in oilfield areas for the Seminole Nation) are considered in making stream impairment/attainment decisions for the Integrated Report, including the 303(d) impaired stream listings (Category 5).

Corp Comm Oil & Gas is also involved with alternative measures to TMDLs for applicable waterbodies in Category 5. Examples of these include such measures as:

- the cleanup of a historic site that is leaking pollutants into ground and/or surface water causing impairment, or
- a finding of irreversible man-induced impacts in a waterbody, with recommendations for changes in the listed beneficial uses until impacts are reduced.

Assessment Methodology

The following methodologies, along with the procedures described in Figure 4 near the end of this section, shall be used to determine the attainment status of a waterbody's designated beneficial uses and its subsequent categorization in this Integrated Water Quality Report.

A waterbody that is listed on the State's current 303(d) list may only be placed in category 1, 2, or 3 of the Integrated Report for "good cause" or if it is demonstrated that new data or information indicate that the waterbody is attaining its designated beneficial uses. "Good cause" shall mean that the State will provide a reasonable basis for the recommendation such as flaws in the original analysis that led to the water being listed; more recent or accurate data; more sophisticated water quality modeling; changes in conditions (e.g., new control equipment or elimination of discharges); or data is insufficient or non-existent to assess that all uses are met and the water should more appropriately be in Category 2 or 3.

Waterbodies in categories 2 & 3 will be prioritized in a manner similar to the category 5 waterbodies. A monitoring schedule will be included for categories 2 & 3 as part of the Integrated Report. Waterbodies included on the most recent 303(d) list will receive the highest priority for future monitoring.

Use Support Assessment Protocol

These procedures closely follow those set forth in the State's Use Support Assessment Protocol (USAP), which can be found in OAC 785:46-15. Where the USAP is silent, this listing methodology should be used. Where there are discrepancies between this methodology and the USAP, the USAP controls.

Beneficial Uses

The Listing Methodology is categorized into beneficial uses. Each beneficial use has a procedure for determining attainment of that use based on various kinds of biological, chemical, and historical data. The result of applying this methodology for any given beneficial use must be one of three choices: "attained", "not attained," and "not enough data to make a determination."

Some beneficial uses have procedures for several different types of data, all of which must be determinable – unless otherwise specified – in order to determine that the beneficial use is attained. Otherwise, the attainment decision must be designated "not enough data to make a determination."

Data Requirements

The data used to make a determination must meet various quantity, quality, spatial, and temporal requirements in order to satisfy the attainment procedures. The following general requirements apply unless otherwise specified in the use-specific procedures that follow. If neither an "attained" nor "not attained" determination can be made, then the overall determination for that beneficial use or subcategory shall be "not enough data to make a determination."

Spatial

- In general, stream sampling locations should take into consideration existing data, spatial distribution of monitoring sites, sources of pollution, and major hydrological features such as tributaries and dams.
- Non-wadable stream samples may represent a maximum of 25 stream miles.
- Wadable stream samples may represent a maximum of 10 stream miles.
- Lake samples may represent a maximum of 250 acres per sample. Arms or portions of lakes may be treated separately from the main body of a lake.
- Samples may not be taken within regulatory mixing zones.

Temporal

- Sampling must represent seasonal variation. Temporal bias should be avoided.
- Stream data older than five (5) years should not be used to make use attainment determinations unless insufficient data exists for the previous five (5) year period.

- Lake data older than ten (10) years should not be used to make use attainment determinations unless insufficient data exists for the previous ten (10) year period.

Quantity

- For streams, a minimum of ten (10) samples is required to determine use attainment for parameters such as DO, pH, temperature, coliform bacteria, dissolved solids, and salts.
- For lakes of more than 250 surface acres, a minimum of twenty (20) samples is required to determine use attainment for parameters such as DO, pH, temperature, coliform bacteria, chlorophyll a, and dissolved solids. For lakes of 250 surface acres or less, a minimum of ten (10) samples is required.
- For toxicants, a minimum of five (5) samples is required to determine use attainment.
- For any type of sample, if existing samples already assure a "not attained" determination, the minimum sample quantity requirement does not apply.

PQLs**Criteria above PQL**

If sample values are below the PQL (Practical Quantitation Limit) for a parameter whose criterion is above the PQL, appropriate nonparametric statistical measures shall be used to determine the reporting value.

For waterbodies identified as impaired on the current Integrated Report, if sample values are nondetectable for a parameter whose criterion is above the PQL, then such value shall be deemed to be one-half (1/2) of the parameter PQL.

All sample values that are above the PQL shall be the reported values.

Criteria below PQL

If sample values are below the PQL for a criterion which is less than one-half (1/2) of the PQL, then the values shall be deemed to be zero (0) until the first test result above the PQL appears. After that time, sample values which are below the PQL shall be deemed to be equal to the criterion value until four (4) subsequent contiguous samples are shown to be below the PQL. Any subsequent sample values which are nondetectable may be treated as zero (0) until the next test result appears above the PQL.

For those parameters whose criteria are at least two (2) orders of magnitude below the PQL, evidence considered with respect to assessment of use support shall include fish tissue analysis, biological community analysis, biological thresholds wherever available, or other holistic indicators which are appropriate for the beneficial use in question.

If sample values are below the PQL for a criterion which is greater than or equal to one-half (1/2) of the PQL but less than the PQL, then the values shall be deemed to be one-half (1/2) of the criterion value until the first test result above the PQL appears. After that time, sample values which are below the PQL shall be deemed to be equal to the criterion value until four (4) subsequent contiguous samples are shown to be below the PQL. Any subsequent sample values which are nondetectable may be treated as equal to one-half (1/2) of the criterion value until the next test result appears above the PQL.

For waterbodies identified as impaired in the current Integrated Report, if sample values are nondetectable for a parameter whose criterion is below the PQL, then such value shall be deemed to be one-half (1/2) of the criterion value.

All sample values that are above the PQL shall be the reported values.

Magnitude of Exceedance

- For toxicants, if two or more samples exceed water quality criteria or screening levels by two orders of magnitude or more, the associated beneficial use is determined to be "not attained."

- For DO, if more than two samples in a stream are below 2 mg/L in a given year, the Fish & Wildlife Propagation beneficial use is determined to be "not attained."

Quality Assurance

Data collected for purposes of use support assessment shall be collected using documented programmatic quality assurance and quality control methods substantially in accordance with those required by "EPA Requirements for Quality Assurance Project Plans", EPA publication no. EPA/240/B-01/003 (March 2001). The methods used shall include protections for sample integrity and the documentation of details on analysis methodologies.

Default Protocol

This method for determining beneficial use attainment should be used where another, more specific method is not provided.

Short Term Average Parameters

Short term average parameters are based on exposure periods of less than seven days, such as sample standards (agriculture beneficial use) and turbidity.

A beneficial use is considered *attained* based on the default protocol for a given short term average parameter if:

10% or fewer of the samples exceed the appropriate screening level or water quality criterion

or

the determination using the default protocol yields "fully supporting but threatened" and the threat will not yield a determination of other than fully supporting within two years of the determination.

A beneficial use is considered *not attained* based on the default protocol for a given short term average parameter if:

greater than 10% of the samples exceed the appropriate screening level or water quality criterion

or

the determination using the default protocol yields "fully supporting but threatened" and the threat will yield a determination of other than fully supporting within two years of the determination.

Long Term Average Parameters

Long term average parameters are based on exposure periods of seven days or longer, such as yearly mean standards (agriculture beneficial use) and fish consumption water column numerical criteria.

A beneficial use is considered *attained* based on the default protocol for a given long term average parameter if:

each 2-year rolling average of the sample results does not exceed the long term average criterion or screening level

or

the determination using the default protocol yields "fully supporting but threatened" and the threat will not yield a determination of other than fully supporting within two years of the determination.

A beneficial use is considered *not attained* based on the default protocol for a given long term average parameter if:

any 2-year rolling average of the sample results exceeds the long term average criterion or screening level

or

the determination using the default protocol yields "fully supporting but threatened" and the threat will yield a determination of other than fully supporting within two years of the determination.

Fish & Wildlife Propagation (F&WP)

The methodology for the Fish & Wildlife Propagation (F&WP) beneficial use consists of eight types of data, each with its own attainment methodology.

The F&WP beneficial use is considered *attained* if:

in the absence of biological data, all six chemical methodologies (DO, Toxicants, pH, Turbidity, Oil & Grease, and Toxicants Not Assessed & Not Likely to Occur or Violate Criteria) result in a determination of *attained*

or

in the absence of adequate data for all six chemical data types, the biological data methodology results in a determination of *attained*.

The F&WP beneficial use is considered *not attained* if *any* of the eight data type methodologies result in a determination of *not attained*.

Dissolved Oxygen (DO)

Streams

A minimum of ten (10) samples is required to make an attainment determination.

The F&WP beneficial use is considered *attained with respect to dissolved oxygen* if 10% or fewer of the samples from a waterbody have a DO concentration of less than:

- 3.0 mg/L (4.0 mg/L from April 1 – June 15) for habitat limited aquatic communities (HLAC)
- 5.0 mg/L (4.0 mg/L from June 16 – October 15) for warm water aquatic communities (WWAC)
- 6.0 mg/L (5.0 mg/L from June 1 – October 15) for trout fisheries and cool water aquatic communities (CWAC)

The F&WP beneficial use is considered *not attained with respect to dissolved oxygen* if more than 10% of the samples from a waterbody have DO concentrations less than those shown above or if more than 2 samples in a given year are below 2 mg/L.

Lakes

For lakes or arms of 250 acres or less, a minimum of ten (10) samples is required to make an attainment determination. For lakes or arms of greater than 250 acres, a minimum of twenty (20) samples is required.

The F&WP beneficial use is considered *attained with respect to dissolved oxygen* if:

more than 50% of the lake water column has a DO concentration of 2.0 mg/L or more

and

90% or more of the surface samples have a DO concentration of 5 mg/L (4.0 mg/L from June 16 – October 15) or more.

The F&WP beneficial use is considered *not attained with respect to dissolved oxygen* if:

50% or more of the lake water column has a DO concentration of less than 2.0 mg/L

or

10% or more of the surface samples have a DO concentration of less than 5 mg/L (4.0 mg/L from June 16 – October 15).

Toxicants

A minimum of five (5) samples is required to make an attainment determination.

The following screening values shall be used to make attainment decisions for toxicants:

- the acute and/or chronic criteria for a given toxicant, as described in Appendix G, Table 2 of the Oklahoma Water Quality Standards, OAC 785:45
- the chronic ammonia toxicity value shown in Table 13 corresponding to the stream pH and temperature at the time of sampling

For metals, preference shall be given to attainment decisions based on dissolved metals in accordance with the procedures specified in OAC 785:46-15-5(h).

ACUTE EFFECTS

The F&WP beneficial use is considered *attained with respect to an individual toxicant* if no more than one (1) of the samples have concentrations of a toxicant that exceed the acute criterion or screening value for that toxicant.

The F&WP beneficial use is considered *not attained with respect to an individual toxicant* if more than one (1) of the samples have concentrations of a toxicant that exceed the acute criterion or screening value for that toxicant.

CHRONIC EFFECTS

The F&WP beneficial use is considered *attained with respect to an individual toxicant* if:

not more than one (1) of the samples have concentrations of a toxicant that exceed the chronic criterion or screening value for that toxicant

or

not more than 10% of the samples have concentrations of a toxicant that exceed the chronic criterion or screening value for that toxicant

The F&WP beneficial use is considered *not attained with respect to an individual toxicant* if more than 10% of the samples have concentrations of a toxicant that exceed the chronic criterion or screening value.

TABLE 13. TEMPERATURE- AND PH-DEPENDENT SCREENING VALUES FOR AMMONIA

pH	Temperature (°C)									
	0	14	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18

7.1	5.67	5.67	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.30	3.78	3.32	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	3.18	3.18	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.80	2.80	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	2.10	2.10	1.91	1.68	1.47	1.29	1.14	1.00	0.879	0.773
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.973	0.855	0.752	0.661
8.3	1.52	1.52	1.39	1.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	1.29	1.29	1.17	1.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	1.09	1.09	0.990	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.920	0.920	0.836	0.735	0.646	0.568	0.499	0.439	0.386	0.339
8.7	0.778	0.778	0.707	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.661	0.661	0.601	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.565	0.565	0.513	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.486	0.486	0.442	0.389	0.342	0.300	0.264	0.232	0.204	0.179

pH

A minimum of ten (10) samples is required to make an attainment determination.

The F&WP beneficial use is considered *attained with respect to pH* if 10% or fewer of the samples fall outside the screening range of 6.5 (minimum) and 9.0 (maximum).

The F&WP beneficial use is considered *not attained with respect to pH* if more than 10% of the samples fall outside the screening range of 6.5 (minimum) and 9.0 (maximum).

Biological Data

Biological criteria have been established for various ecoregions in Oklahoma under OAC 785:46-15-5. See Figure 3. These biocriteria should be referenced when making attainment determinations. OAC 785:46 Appendix C Index of Biological Integrity should be used for these ecoregions. This methodology is only applicable to wadable streams.

For waterbodies where no biological data is available, a resulting determination of "attained" with respect to all six chemical data type methodologies (DO, pH, Toxicants, Turbidity, Oil & Grease, and Toxicants Not Assessed & Not Likely to Occur or Violate Criteria) may serve to determine attainment of the F&WP beneficial use.

For waterbodies where *only* biological data is available, a determination of "attained" with respect to biological criteria may serve to determine attainment of the F&WP beneficial use.

The F&WP beneficial use is considered *attained with respect to biological criteria* if:

for streams in ecoregions where biological thresholds have been determined, a biological assessment yields an Index of Biotic Integrity (IBI) associated with "fully supported."

or

for streams outside of ecoregions where biological thresholds have been determined, fish and benthic invertebrate communities are at least 70% similar to communities found in regional reference conditions considering the beneficial use sub-category appropriate for the stream in question.

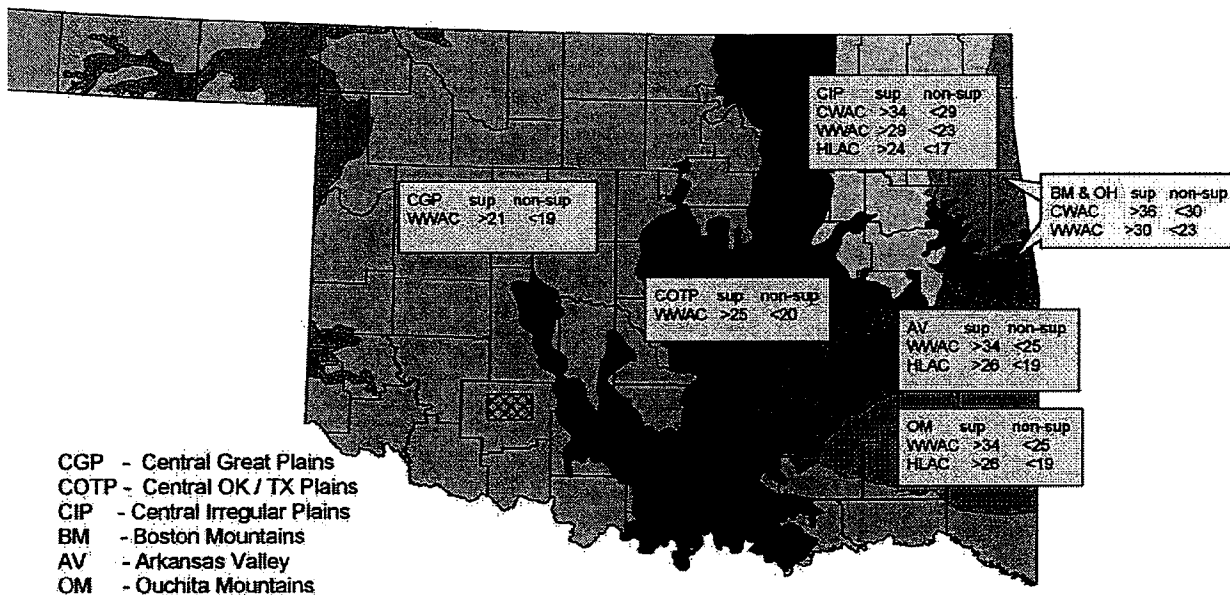
The F&WP beneficial use is considered *not attained with respect to biological criteria* if:

for streams in ecoregions where biological thresholds have been determined, a biological assessment yields an Index of Biotic Integrity (IBI) associated with "partially supported" or "not supported."

or

for streams outside of ecoregions where biological thresholds have been determined, fish and benthic invertebrate communities are less than 40% similar to communities found in regional reference conditions considering the beneficial use sub-category appropriate for the stream in question.

FIGURE 4. ECOREGIONS WHERE BIOCRITERIA HAVE BEEN ESTABLISHED



NOTE: criteria do not apply to crosshatched area

Ref: OAC 785:46-15-5(h) through (m)

Turbidity

A minimum of ten (10) samples collected under seasonal base flow conditions is required to make an attainment determination.

The following numerical criteria shall be used to make attainment decisions for turbidity:

- 10 Nephelometric Turbidity Units (NTUs) for cool water aquatic communities and trout fisheries
- 25 NTUs for lakes
- 50 NTUs for other surface waters

The F&WP beneficial use is considered *attained with respect to turbidity* if:

10% or fewer of the samples exceed the appropriate screening level or water quality criterion.